

CLAIMS

- 1 1. A method for determining a vehicle trip on a roadway, the method comprising:
2 providing a plurality of vehicle detections from a plurality of gateways;
3 determining a maximum travel time between corresponding pairs of the plurality
4 of gateways;
5 correlating corresponding pairs of the plurality of vehicle detections by
6 determining that a travel time between each of the gateways of each of the corresponding
7 pairs of detections is less than a corresponding maximum travel time;
8 determining a plurality of chainable detections; and
9 determining the boundaries of the trip.
- 1 2. The method of claim 1 wherein providing the plurality of vehicle detections
2 comprises providing at least one license plate image corresponding to one of the plurality
3 of vehicle detections.
- 1 3. The method of claim 2 further comprising:
2 determining a vehicle license plate number; and
3 processing the at least one license plate image for verifying the vehicle license
4 plate number
- 1 4. The method of claim 1 wherein providing the plurality of vehicle detections
2 comprises filtering a plurality of vehicle transactions for providing the plurality of vehicle
3 detections.
- 1 5. The method of claim 4 wherein the plurality of vehicle transactions includes at
2 least one ambiguous transaction; and
3 further comprising eliminating at least one ambiguous transaction from the
4 plurality of vehicle transactions.
- 1 6. The method of claim 5 wherein the at least one ambiguous transaction includes a
2 conflicting gateway crossing.

2025-10-10 10:59:10

- 1 7. The method of claim 4 further comprising eliminating dual transactions from the
2 plurality of vehicle detections.
- 1 8. The method of claim 1 wherein correlating the corresponding pair of the plurality
2 of vehicle detections further comprises determining whether each of the pair of detections
3 is provided by a corresponding pair of gateways that are disposed logically consistent
4 with the roadway topology.
- 1 9. The method of claim 1 wherein correlating the corresponding pair of the plurality
2 of vehicle detections further comprises determining that the travel time between each of
3 the detections is greater than a minimum travel time.
- 1 10. The method of claim 1 wherein determining a maximum travel time comprises
2 determining an incident free maximum travel time.
- 1 11. The method of claim 10 further comprising:
2 determining an expected travel time; and
3 determining that the maximum travel time is the longer of the expected travel
4 time and the incident free maximum travel time.
- 1 12. The method of claim 11 further comprising:
2 detecting a traffic incident; and
3 modifying the expected travel time in response to the traffic incident.
- 1 13. The method of claim 1 further comprising waiting for the plurality of chainable
2 detections to be initially processed.
- 1 14. The method of claim 1 further comprising waiting for the plurality of chainable
2 detections to be verified.
- 1 15. The method of claim 13 further comprising determining a latest time for the
2 plurality of detections.
- 1 16. The method of claim 1 wherein determining the boundaries comprises detecting

2 the end of the trip.

1 17. The method of claim 16 wherein detecting the end of the trip comprises:
2 determining a maximum detection time for the plurality of chainable detections;
3 determining a current boundary time;
4 comparing the current boundary time to the maximum detection time; and
5 declaring the end of the trip in response to determining that the current boundary
6 time is greater than the maximum detection time.

1 18. The method of claim 1 wherein determining the boundaries comprises detecting
2 the start of the trip.

1 19. The method of claim 1 further comprising forming the trip by chaining the
2 plurality of chainable detections.

1 20. The method of claim 1 further comprising waiting for the plurality of chainable
2 detections.

1 21. The method of claim 20 wherein waiting for all detections that might chain
2 comprises:
3 determining a first time wherein each of the plurality of chainable detections has a
4 first extrapolation region terminating earlier than the first time.

1 22. The method of claim 21 further comprising:
2 determining a second time wherein each of the plurality of chainable detections
3 occurring later than the first time has a second extrapolation region terminating earlier
4 than the second time, is evaluated for verifying.

1 23. The method of claim 22 verifying transactions occurring between the first time
2 interval and the second interval time using a video image of a license plate number
3 captured at the time of the detection.

1 24. The method of claim 22 wherein verifying transactions comprises automatically
2 recognizing the license plate number from the image.

- 1 25. The method of claim 22 wherein verifying transactions comprises manually
2 reading the license plate number from the image.
- 1 26. The method of claim 1 wherein the plurality of vehicle transactions is provided by
2 at least one of:
3 an enforcement gateway; and
4 a toll gateway sensor.
- 1 27. The method of claim 1 wherein each of the plurality of vehicle detections
2 comprises:
3 a time of the detection; and
4 the location of the detection.
- 1 28. The method of claim 1 wherein determining the boundaries of the trip comprises
2 using at least one of:
3 a traffic incident; and
4 a set of billing policies.
- 1 29. A method for determining a vehicle trip on a roadway having a plurality of
2 gateways disposed according to a roadway topology, the method comprising:
3 providing a model of the topology including gateway connectivity, a plurality of
4 minimum travel times between pairs of gateways, and a plurality of incident free
5 maximum travel times between pairs of gateways;
6 providing a plurality of vehicle detections;
7 providing a set of rules for applying the model;
8 correlating the plurality of vehicle detections by applying the rules to the plurality
9 of vehicle detections; and
10 determining a plurality of chainable vehicle detections forming the trip.
- 1 30. The method of claim 29 further comprising determining a plurality of expected
2 travel times between the pairs of gateways.

- 1 31. The method of claim 30 further comprising chaining the plurality of chainable
2 vehicle detections for forming a potential trip.
- 1 32. The method of claim 31 further comprising verifying a license plate reading
2 corresponding to at least one of the plurality of chainable vehicle detections.
- 1 33. The method of claim 32 further comprising waiting for required verification of at
2 least one of the plurality of chainable vehicle detections in the potential trip; and
3 chaining the plurality of chainable vehicle detections to form the trip.
- 1 34. A toll collection system comprising:
2 a plurality of gateways;
3 a trip determination processor comprising:
4 a transaction processor;
5 a vehicle detection correlation processor coupled to the transaction
6 processor;
7 a transaction filter processor coupled to the vehicle detection correlation
8 processor;
9 an end of a trip detection processor coupled to the transaction filter
10 processor;
11 a start of a trip detection processor coupled to the transaction filter
12 processor; and
13 a trip formation processor coupled to the transaction filter processor, the
14 end of a trip detection processor, and the start of a trip detection processor.
- 1 35. The system of claim 34 wherein the plurality of gateway is adapted for an open
2 ticket tolling system.
- 1 36. The system of claim 34 wherein the plurality of gateway is adapted for a closed
2 ticket tolling system.
- 1 37. The system of claim 34 wherein the plurality of gateway is adapted for an open
2 ticket enforcement system.

- 1 38. The system of claim 34 wherein the plurality of gateway is adapted for a mixed open
2 ticket, closed ticket tolling system.

20250707085000